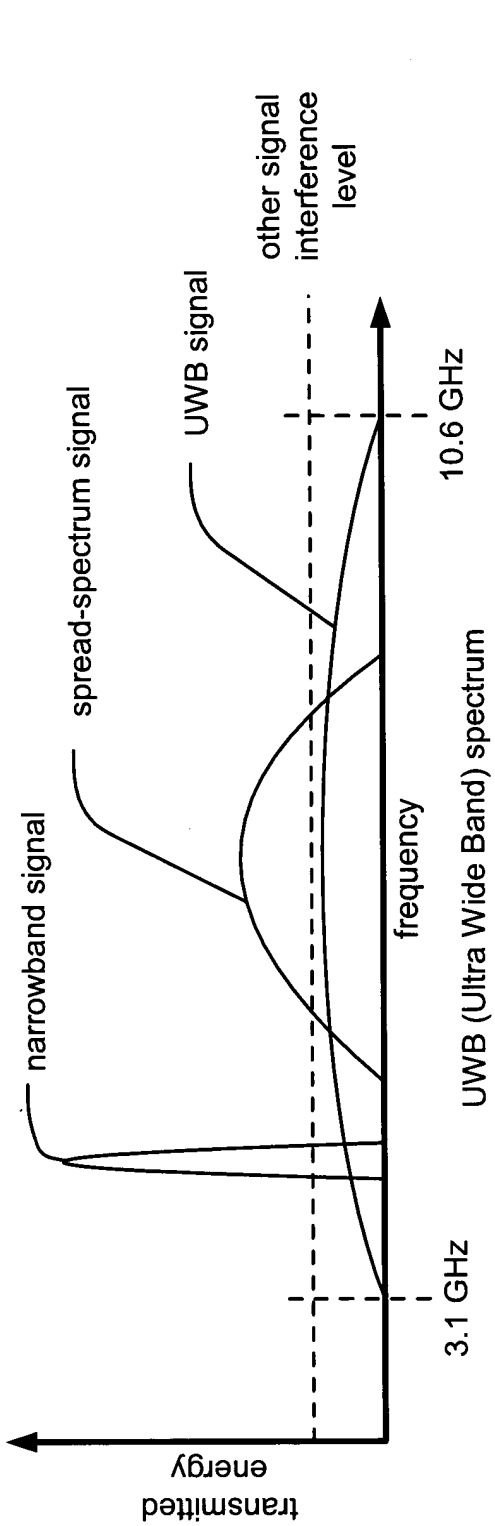

transmitted energy
narrowband signal
spread-spectrum signal
UWB signal
other signal interference level
3.1 GHz
10.6 GHz
frequency
UWB (Ultra Wide Band) spectrum

Fig. 1A

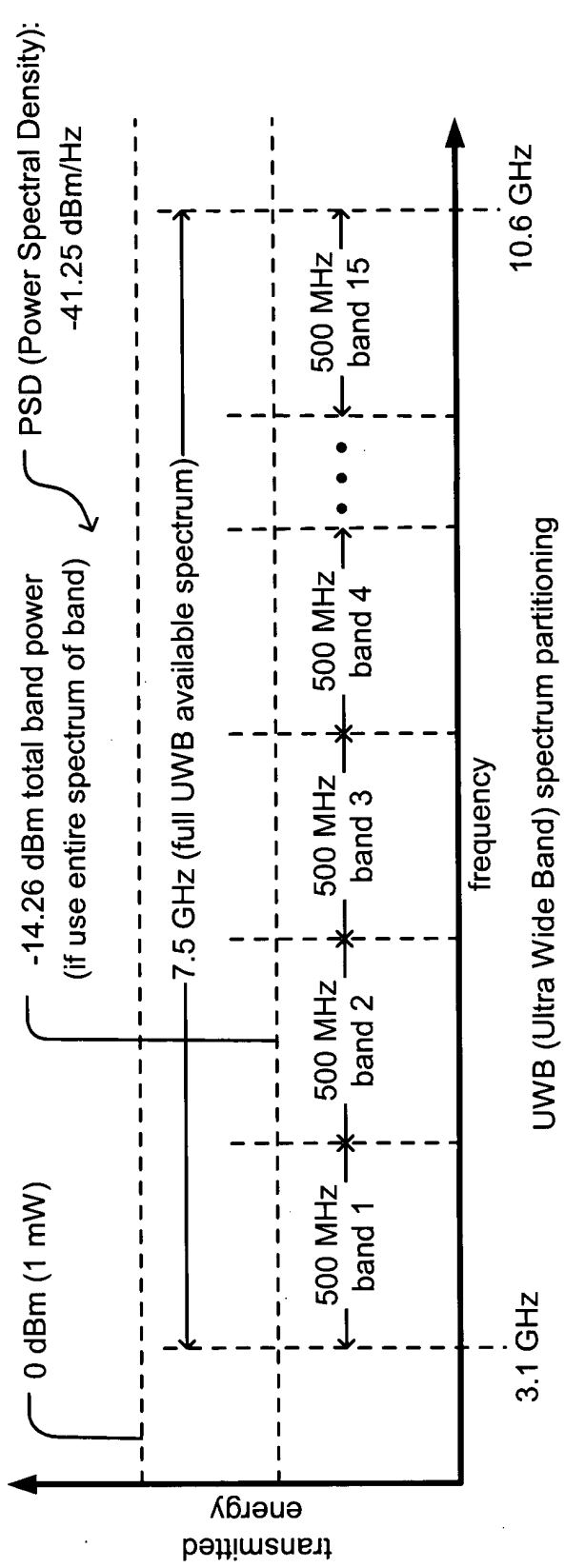
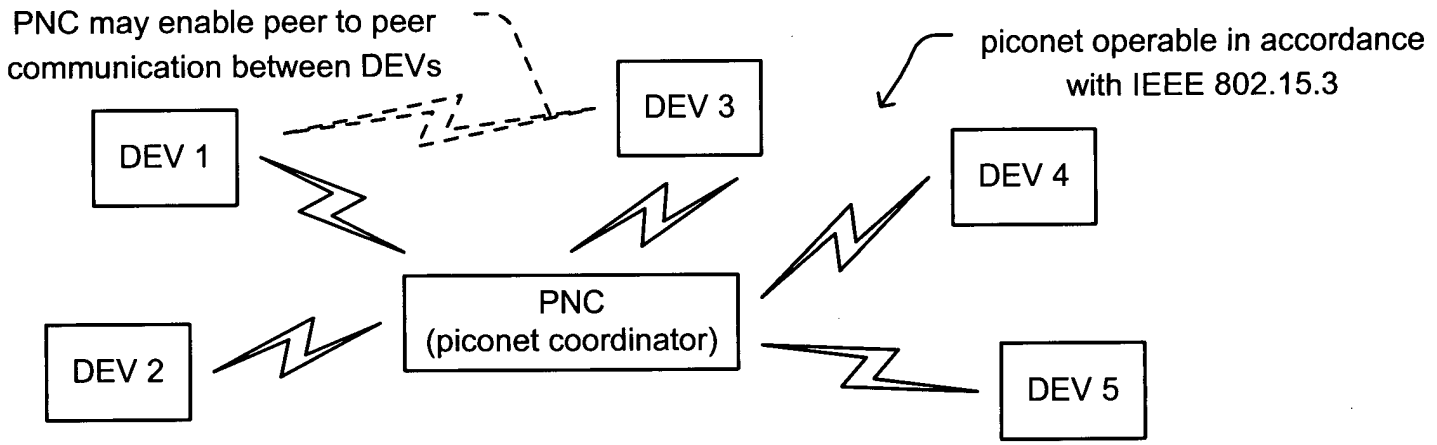
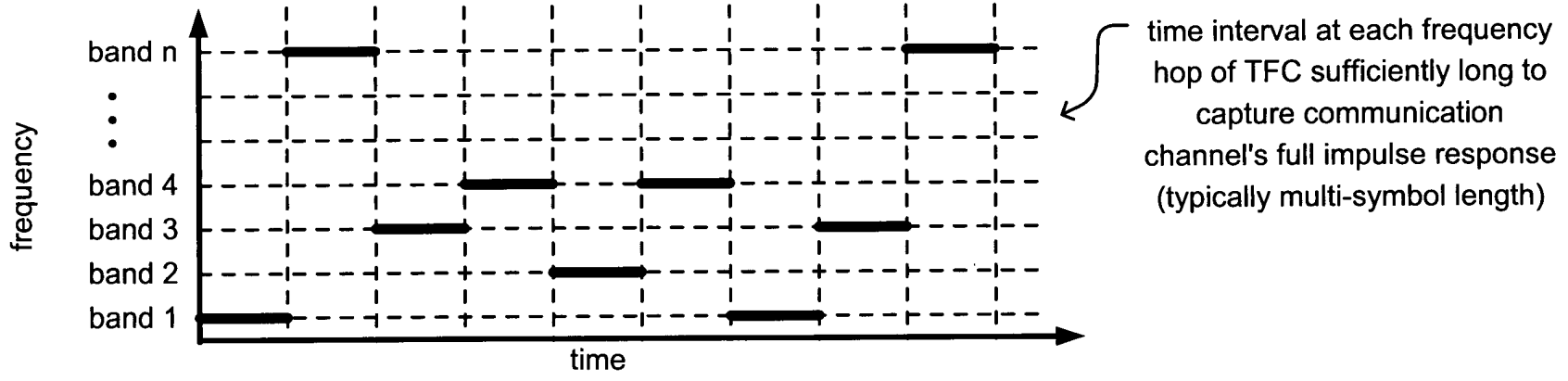

transmitted energy
0 dBm (1 mW)
-14.26 dBm total band power (if use entire spectrum of band)
PSD (Power Spectral Density): -41.25 dBm/Hz
7.5 GHz (full UWB available spectrum)
500 MHz band 1
500 MHz band 2
500 MHz band 3
500 MHz band 4
500 MHz band 15
3.1 GHz
10.6 GHz
frequency
UWB (Ultra Wide Band) spectrum partitioning

Fig. 1B



piconet (shown in wireless communication system embodiment)

Fig. 2A



TFC (time frequency code) (having period)

Fig. 2B

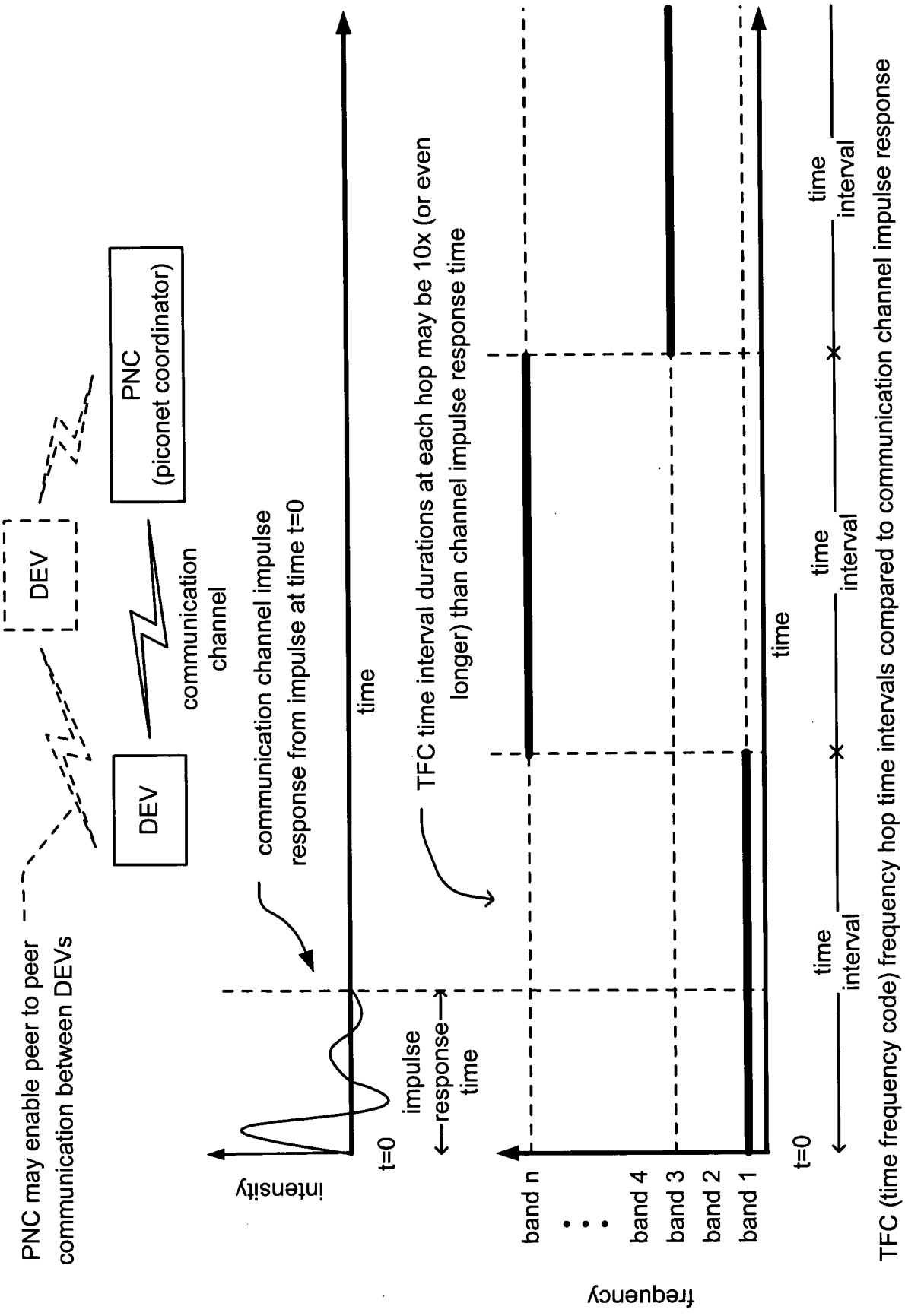


Fig. 3

TFC (time frequency code) frequency hop time intervals compared to communication channel impulse response

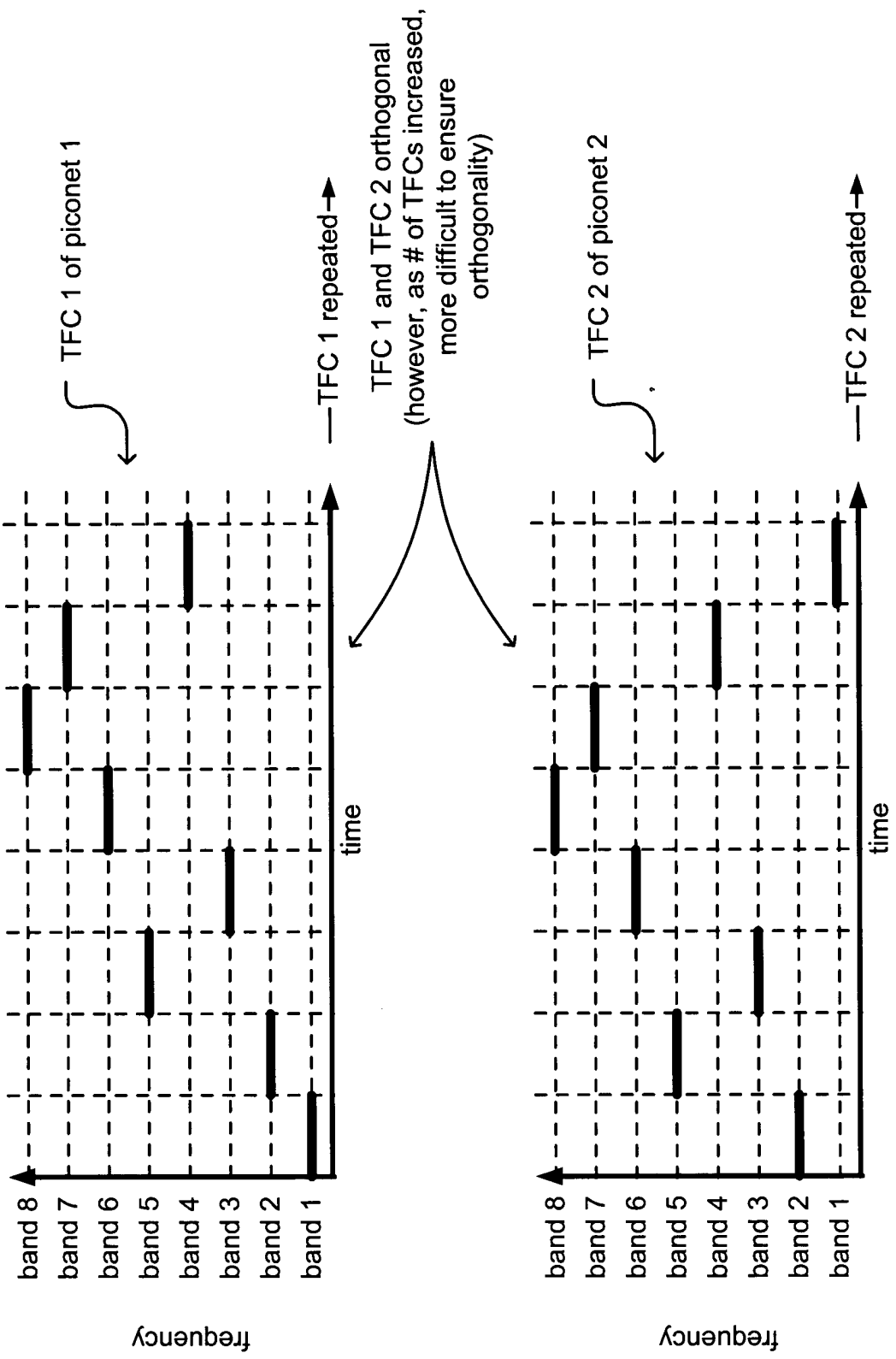
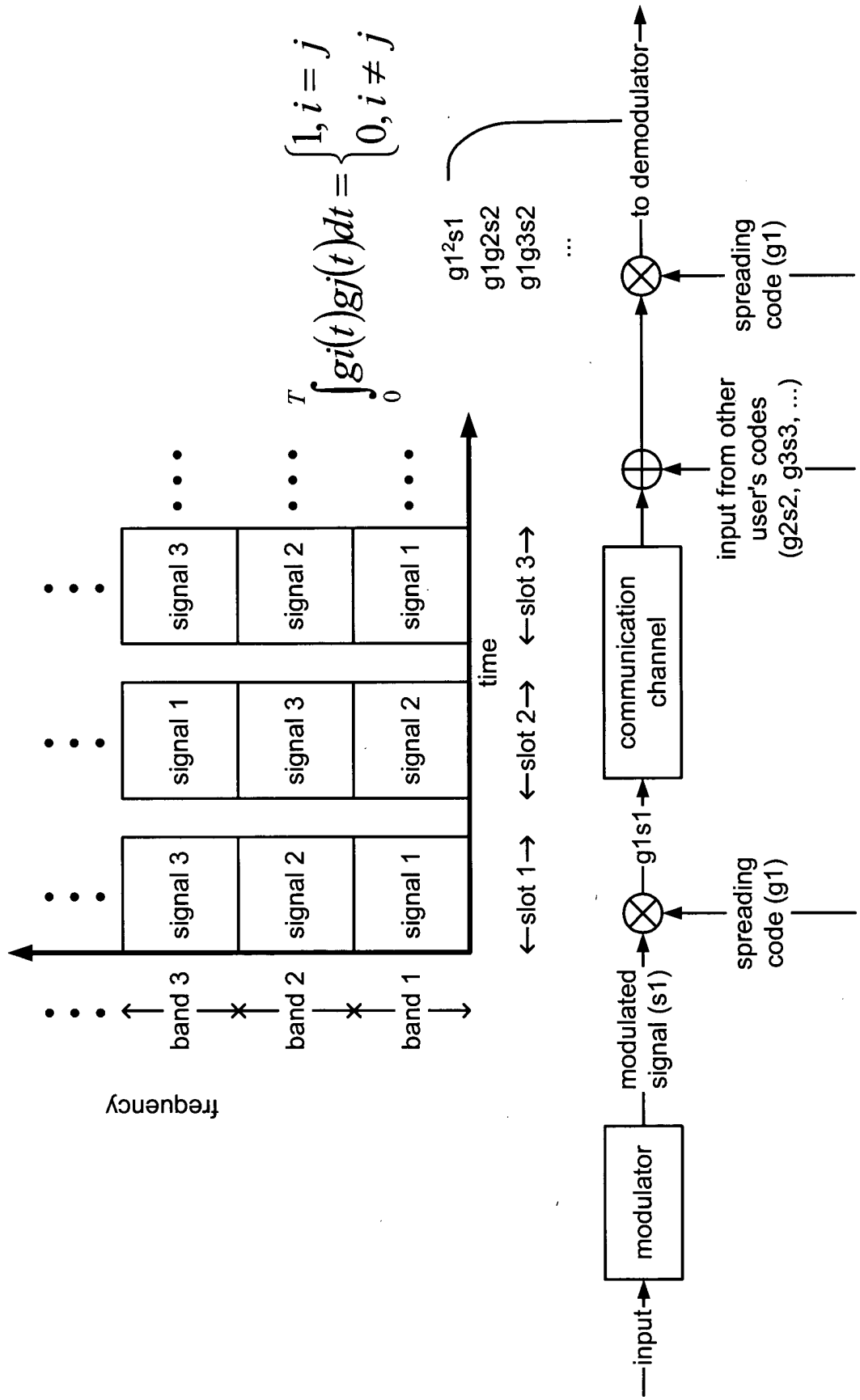

TFC 1 of piconet 1
TFC 1 repeated
TFC 1 and TFC 2 orthogonal (however, as # of TFCs increased, more difficult to ensure orthogonality)
TFC 2 of piconet 2
TFC 2 repeated
band 8
band 7
band 6
band 5
band 4
band 3
band 2
band 1
frequency
time
TFC (time frequency code)

Fig. 4



CDMA (Code Division Multiple Access)

Fig. 5

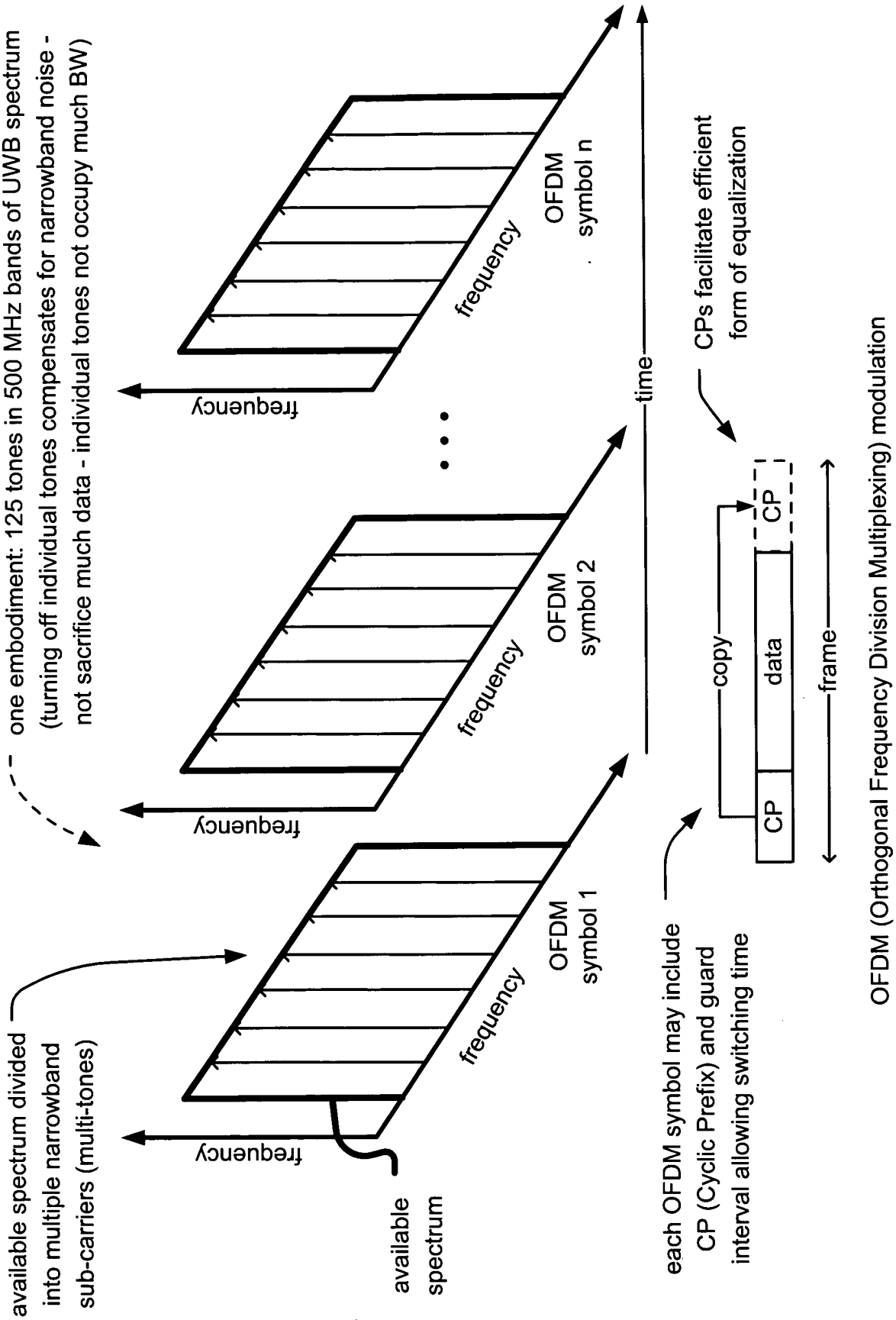
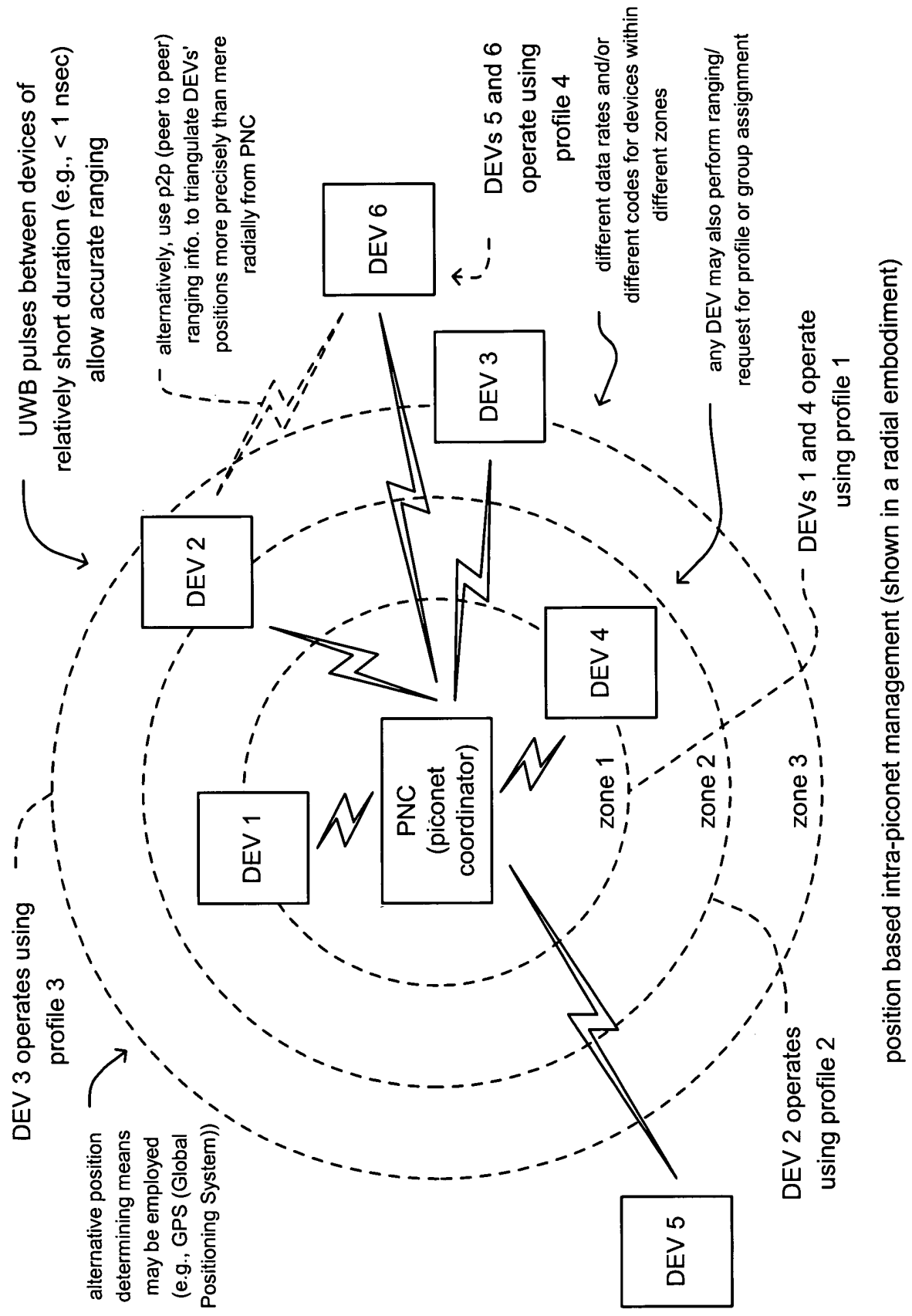

available spectrum divided into multiple narrowband sub-carriers (multi-tones)
one embodiment: 125 tones in 500 MHz bands of UWB spectrum (turning off individual tones compensates for narrowband noise - not sacrifice much data - individual tones not occupy much BW)
available spectrum
frequency
OFDM symbol 1
OFDM symbol 2
OFDM symbol n
time
each OFDM symbol may include CP (Cyclic Prefix) and guard interval allowing switching time
CPs facilitate efficient form of equalization
copy
CP
data
CP
frame
OFDM (Orthogonal Frequency Division Multiplexing) modulation

Fig. 6



position based intra-piconet management (shown in a radial embodiment)

Fig. 7

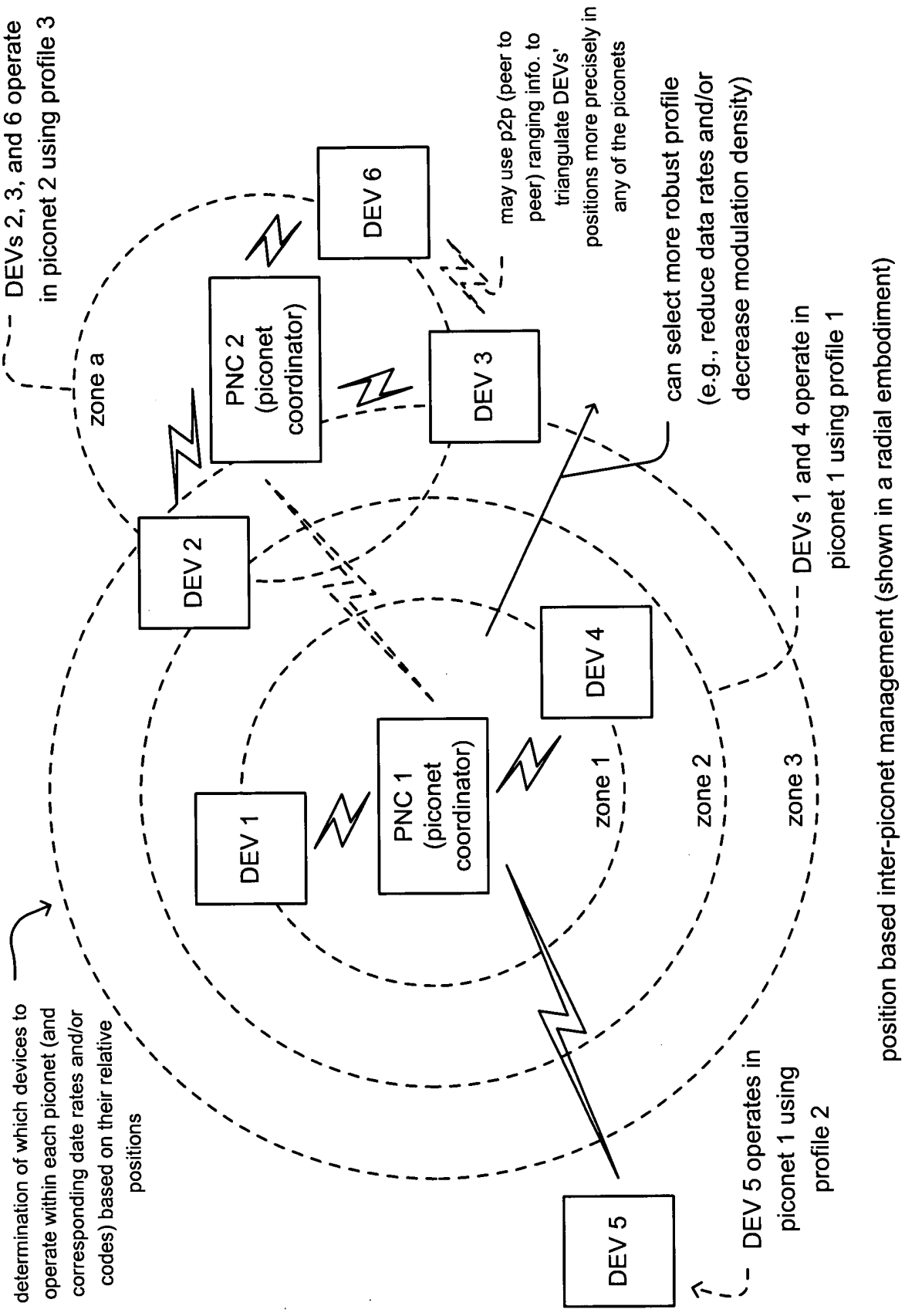

DEVs 2, 3, and 6 operate in piconet 2 using profile 3
zone a
DEV 6
PNC 2 (piconet coordinator)
DEV 3
may use p2p (peer to peer) ranging info. to triangulate DEVs' positions more precisely in any of the piconets
DEV 2
can select more robust profile (e.g., reduce data rates and/or decrease modulation density)
DEV 4
DEV 1
PNC 1 (piconet coordinator)
zone 1
zone 2
zone 3
DEVs 1 and 4 operate in piconet 1 using profile 1
determination of which devices to operate within each piconet (and corresponding date rates and/or codes) based on their relative positions
DEV 5
DEV 5 operates in piconet 1 using profile 2
position based inter-piconet management (shown in a radial embodiment)

Fig. 8

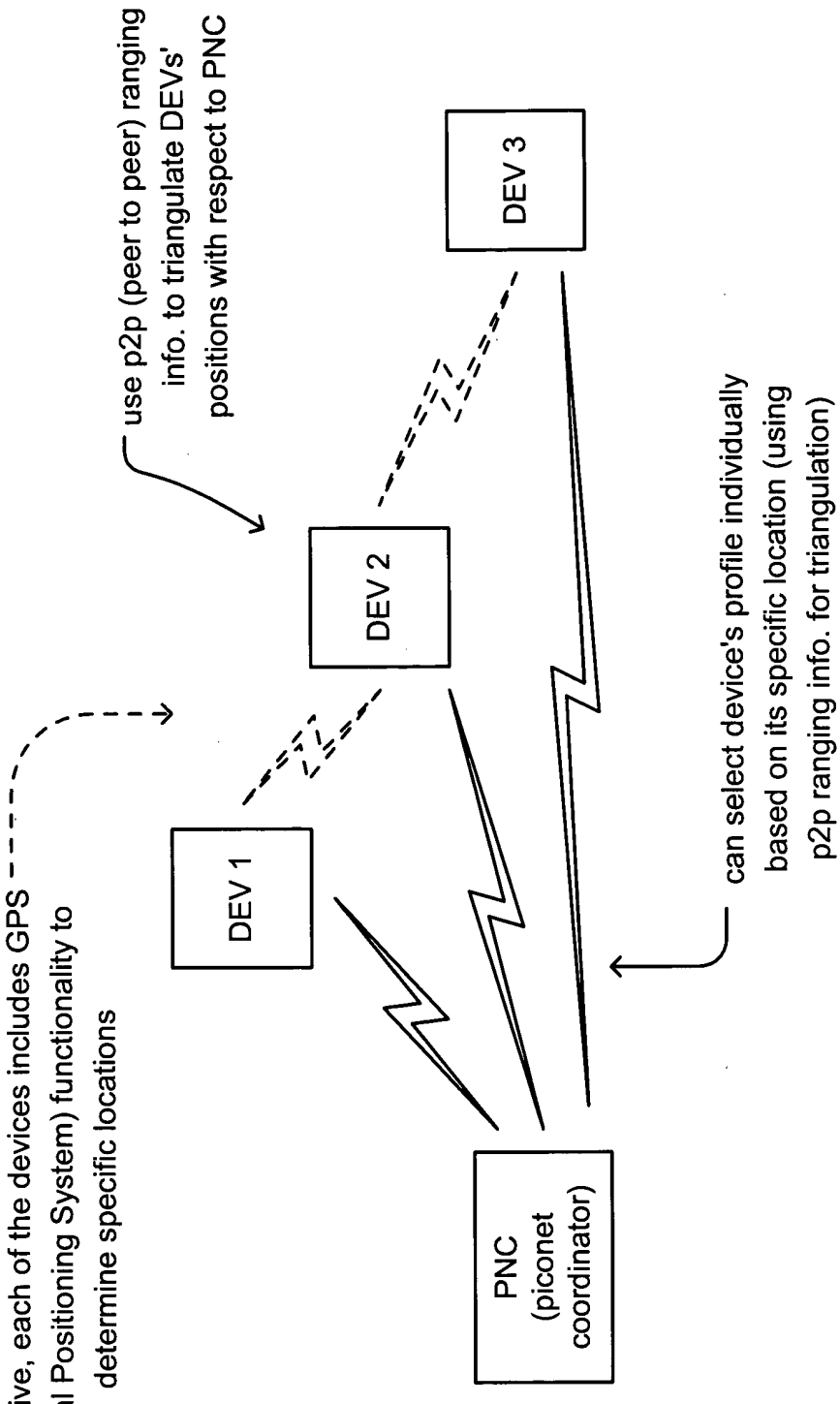
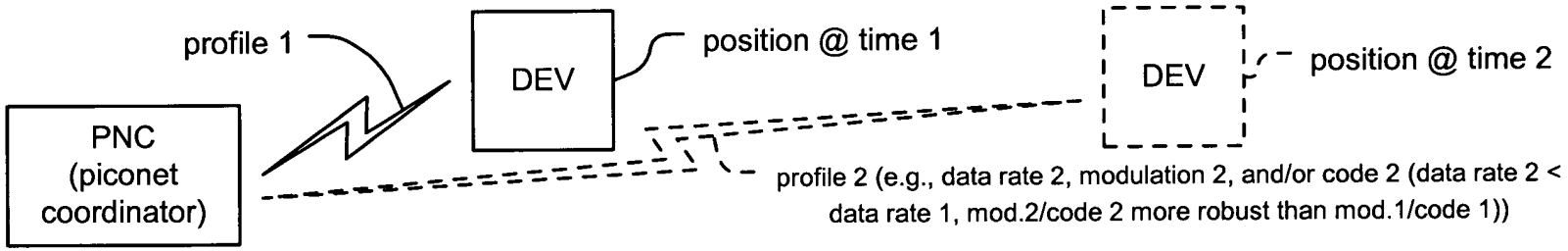


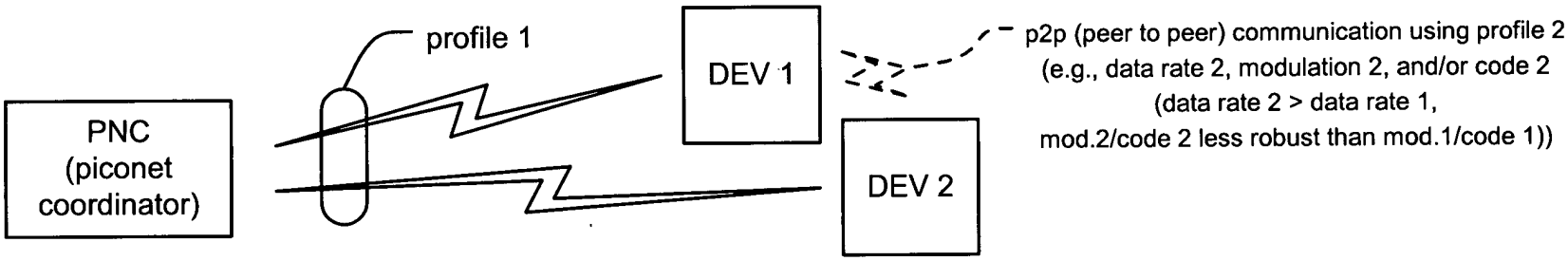
Fig. 9

position based intra-piconet management (shown using triangulation)



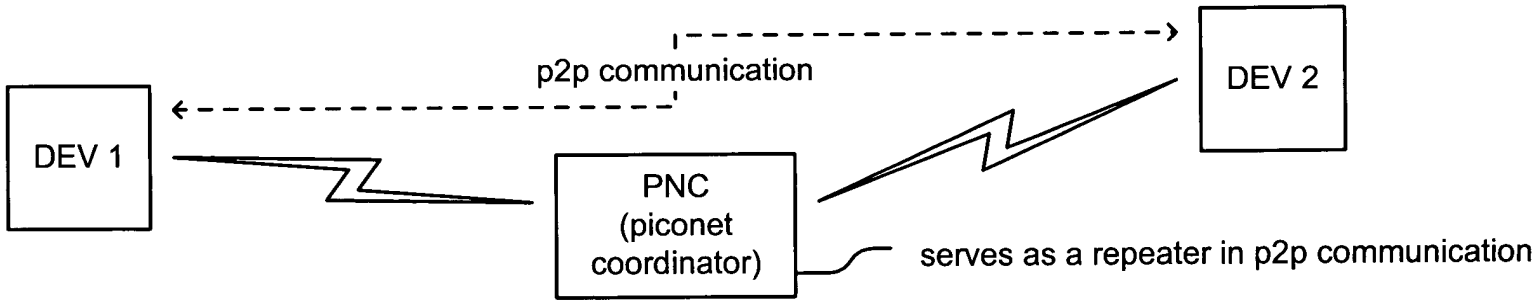
profile modification based on change in relative positions

Fig. 10A



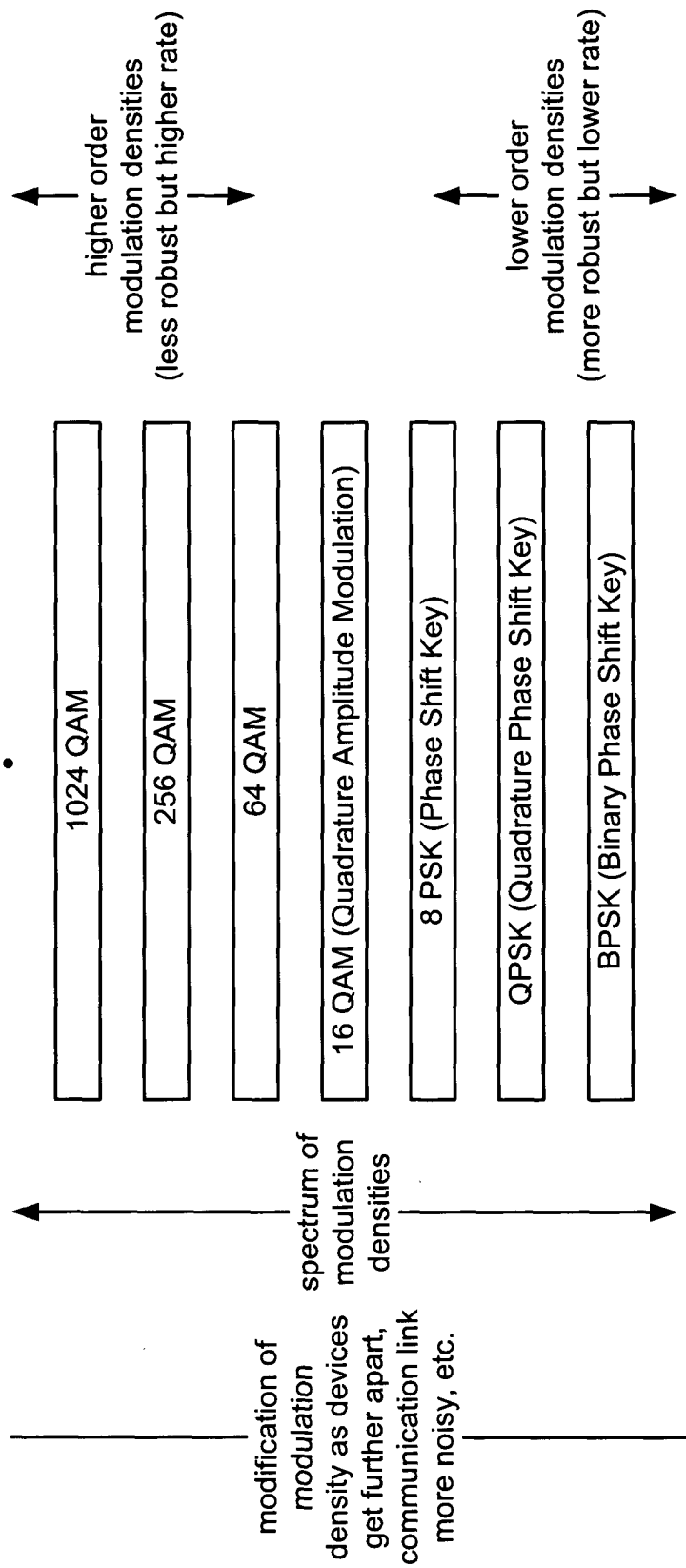
PNC sets up p2p (peer to peer) communication based on relative positions of DEVs

Fig. 10B



position based intra-piconet management

Fig. 10C



example modulation density modification based on position of devices

Fig. 11

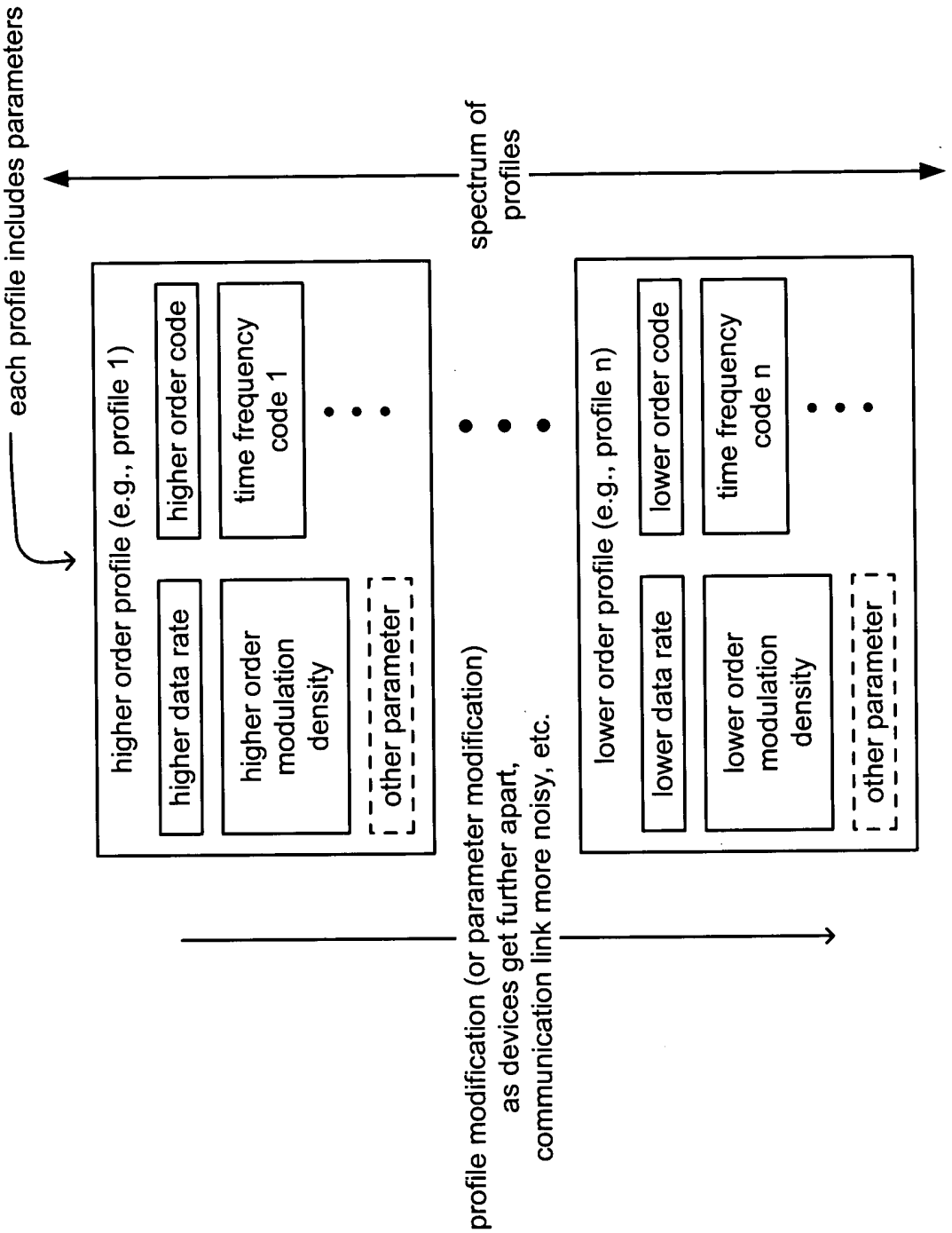

each profile includes parameters
higher order profile (e.g., profile 1)
higher data rate
higher order code
higher order modulation density
time frequency code 1
other parameter
spectrum of profiles
profile modification (or parameter modification) as devices get further apart, communication link more noisy, etc.
lower order profile (e.g., profile n)
lower data rate
lower order code
lower order modulation density
time frequency code n
other parameter
example profile modification (or parameter modification) based on position of devices

Fig. 12

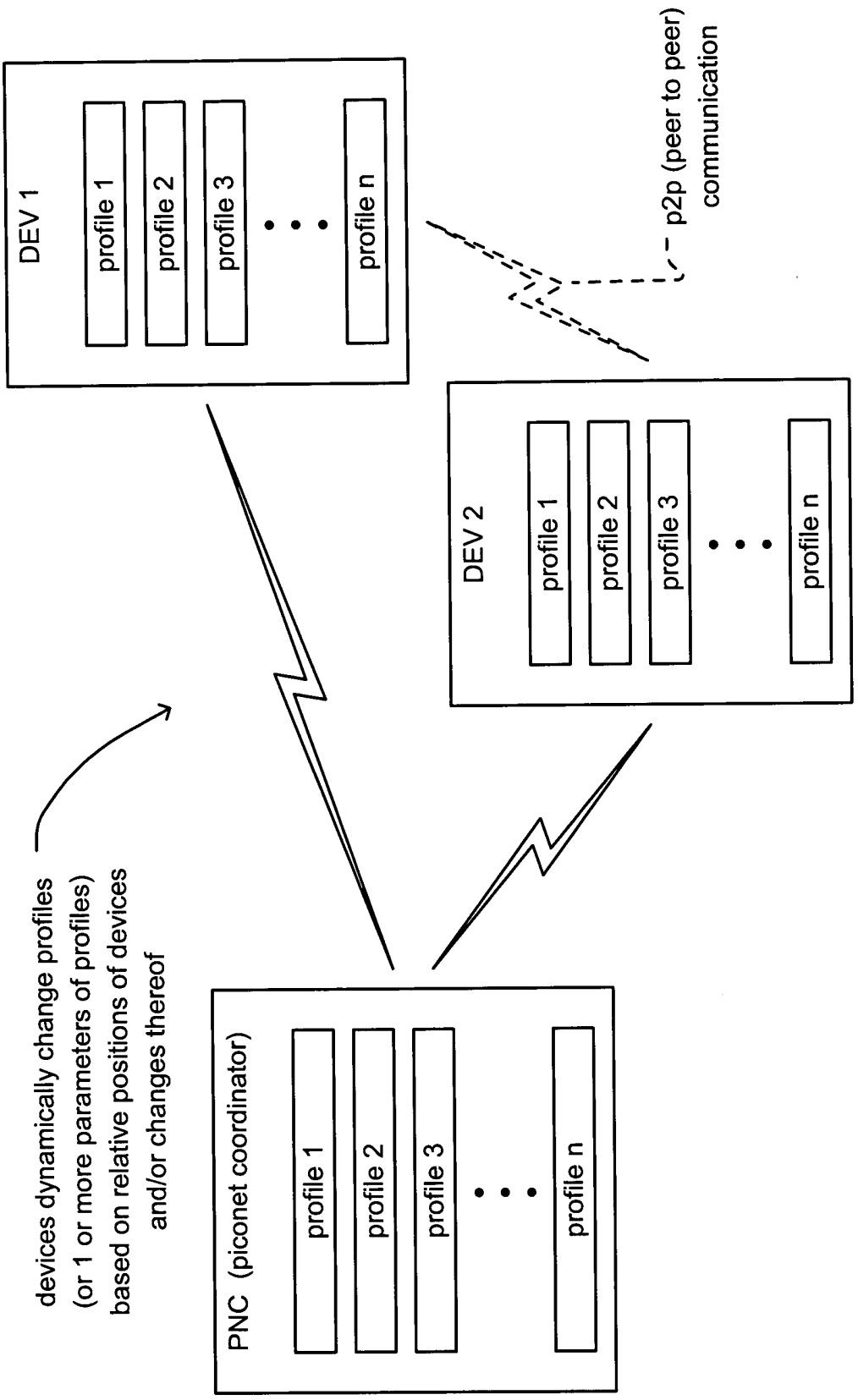
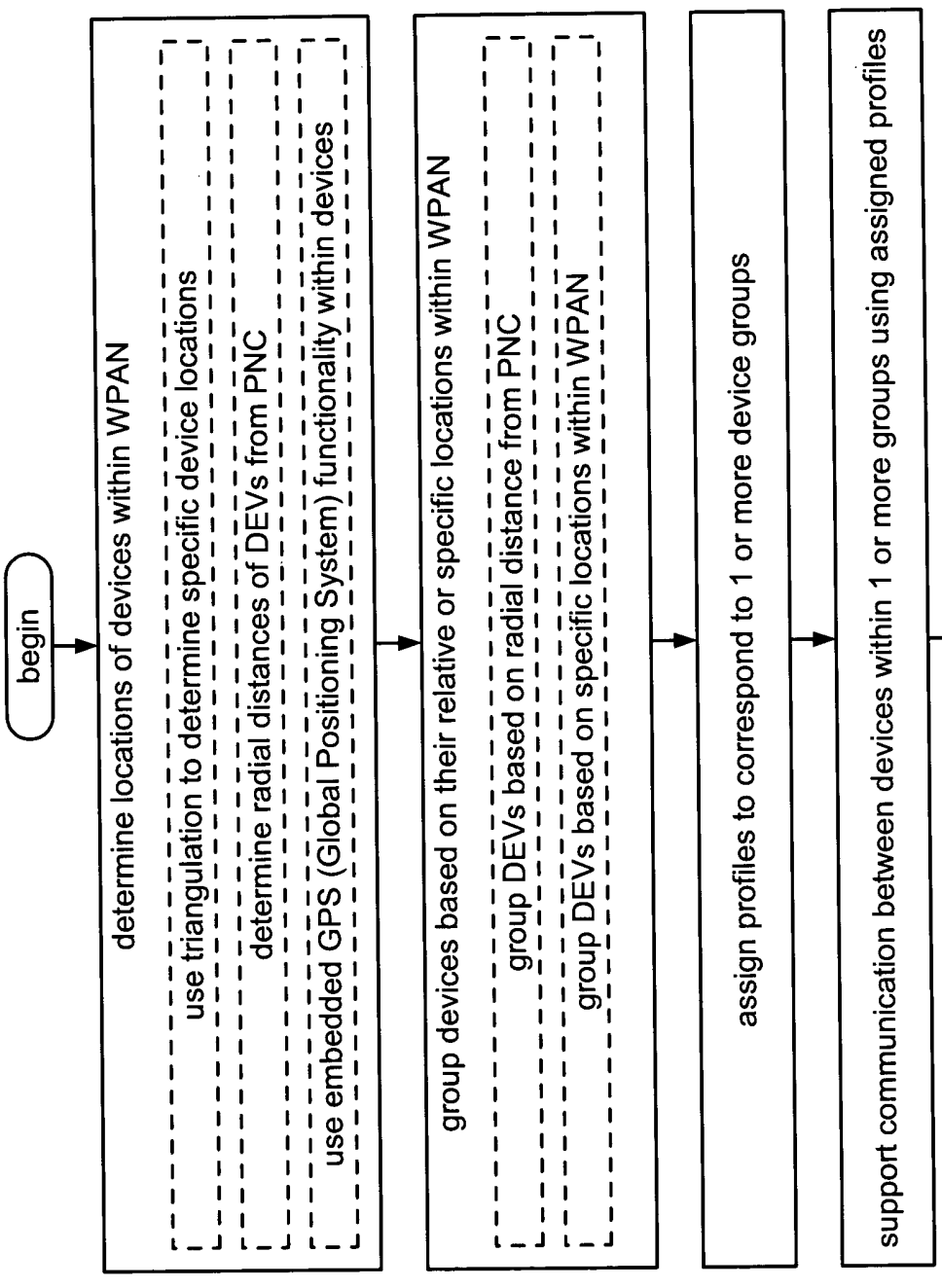
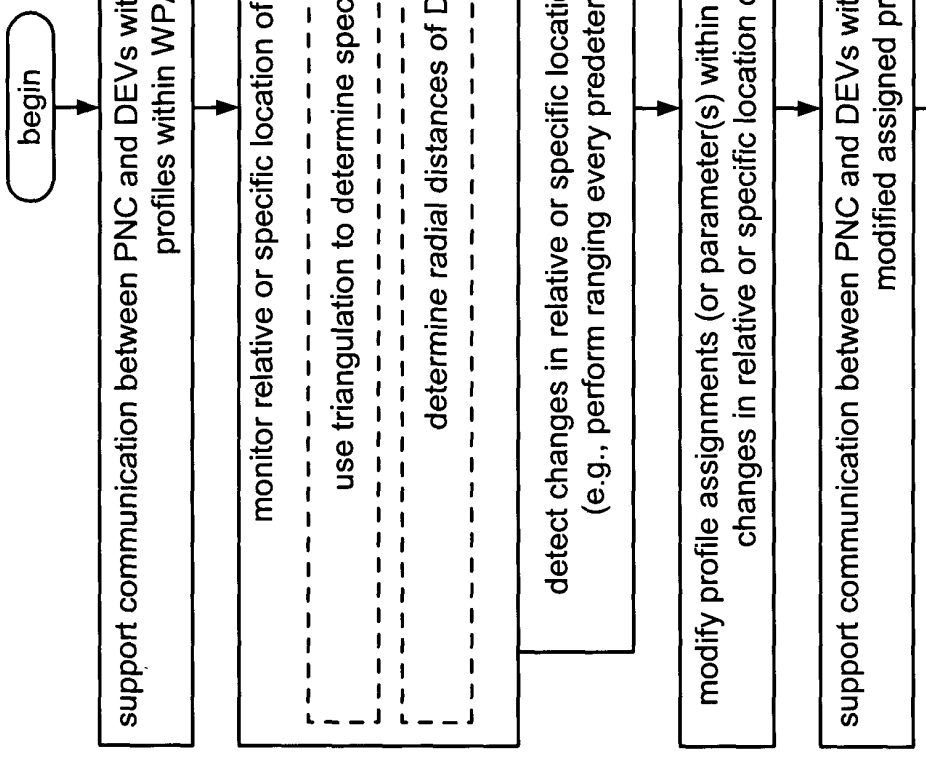

DEV 1
profile 1
profile 2
profile 3
profile n
p2p (peer to peer) communication
DEV 2
profile 1
profile 2
profile 3
profile n
PNC (piconet coordinator)
profile 1
profile 2
profile 3
profile n
devices dynamically change profiles (or 1 or more parameters of profiles) based on relative positions of devices and/or changes thereof
predetermined, finite set of profiles (and corresponding parameters) stored within devices

Fig. 13



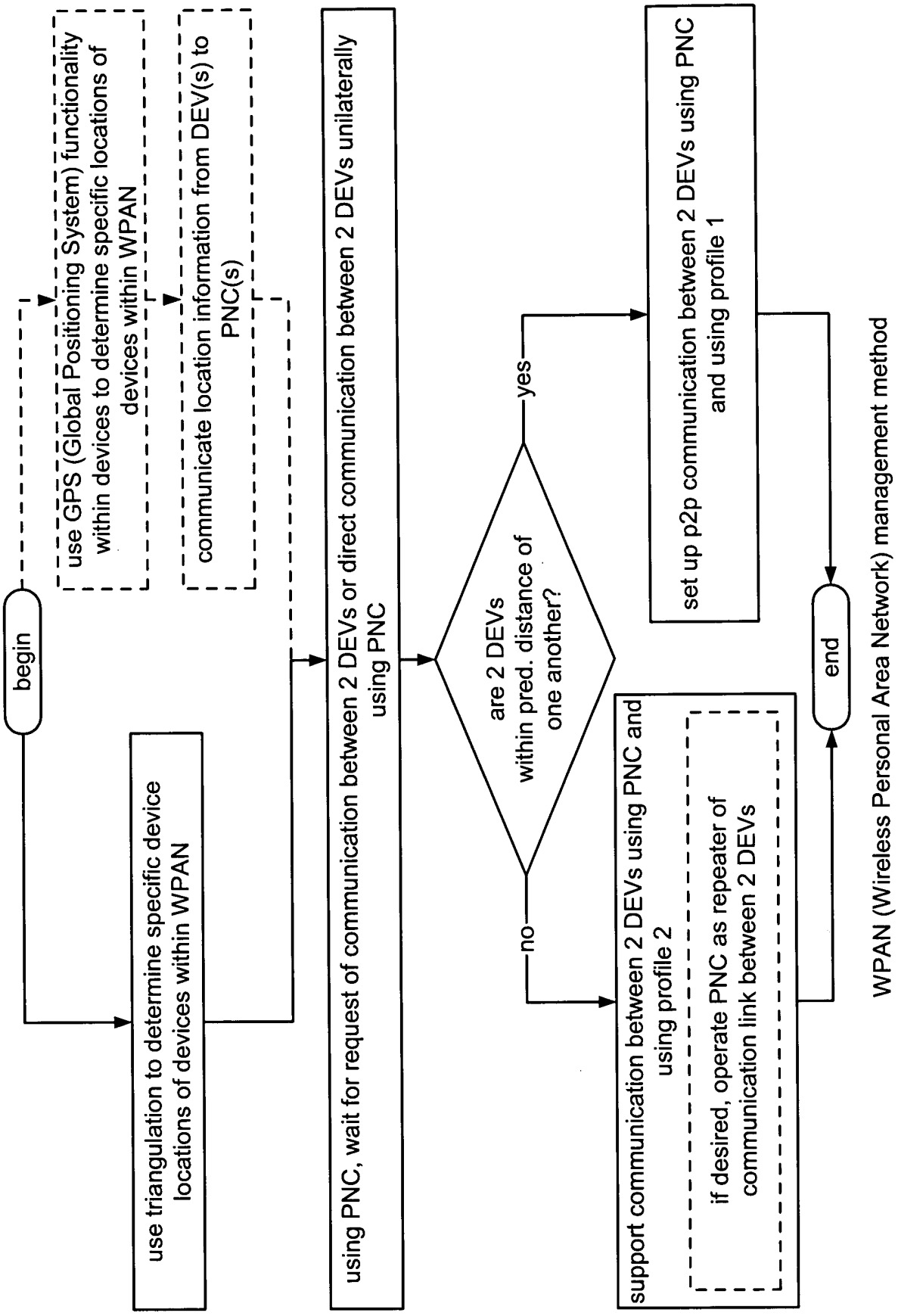
WPAN (Wireless Personal Area Network) management method

Fig. 14



WPAN (Wireless Personal Area Network) management method

Fig. 15



WPAN (Wireless Personal Area Network) management method

Fig. 16